Original article

Epistemological characterization of the teaching-learning process of chemistry and the professionalization of its contents in the training of agronomy technicians

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ABSTRACT

In order to contribute to solve the insufficiencies in the treatment of the relations between the chemical contents and the professional ones, in the formation of the Middle Technician in Agronomy, the present article is elaborated. The use of theoretical level methods such as: analytical-synthetic; inductive-deductive; hermetic-dialectic and induction-deduction, allows presenting as main result, the theoretical referents, which, in the authors' opinion, support the teaching-learning process of Chemistry and the professionalization of its contents. From the critical positions assumed, the referred processes are understood and the theoretical and contextual framework of the current research is formed.

Keywords: Characterization; Teaching-learning process; Chemical contents; Professionalization.

Introduction

To penetrate into the study of the teaching-learning process of Chemistry, presupposes clarifying the most general theoretical referents that from the sciences of Education support it, in the specialty of Agronomy. The objective of this article is to offer an epistemological assessment that allows delimiting the main theoretical references that support this process, in order to allow its understanding, to attenuate the insufficiencies in the treatment of the relationships between chemical contents and professionals, which is posed as a research problem.

From this point of view, it is recognized that this process orients the cognitive activity of the future professional, from the integration of the polytechnic school and the labor entity.

In this order, the article approaches from a critical and reflective view the main theoretical references of the teaching-learning process of Chemistry in the training of the Middle Technician in Agronomy and the professionalization of its contents, which facilitate its understanding and establish the theoretical and contextual framework of this research.

Development

This process is based on Marxist-Leninist philosophy and materialist dialectics as a general methodology, from which the theory of knowledge and the category of activity are taken as essential referents to achieve the student's passage through the stages of knowledge of objects and phenomena related to the agricultural productive process. In relation to this, it is considered that the forms of activity constitute the fundamental way for the acquisition of the referred knowledge.

Thus, the cognitive activity allows revealing the student's relationship with the agricultural production process, through the application of the content in practical activities. Meanwhile, the value activity favors the appreciation of the referred process, based on the meaning and sense it acquires for the student. In this order, the practical activity is recognized as the nucleus that structures the system of activities, which reaches an important value in the teaching-learning process of chemistry, because through it the student can value the agricultural productive process, once inserted in the work entity, under the guidance and cooperation of teachers, specialists-instructors and tutors.

From a sociological perspective, these activities constitute the fundamental socializing

means for the assimilation by the student of the chemical contents studied. The above points out the need to intend the practical activity from the articulation between socialization and individualization, whose main socializing agencies are the polytechnic school and the work entity.

Its social functions respond to the social demand of the Professional Model for the Agronomy specialty, in correspondence with the social and labor demands. This favors the specialization of the student through the productive labor activity, which becomes at the same time a factor of socialization and individualization in correspondence with the historical conditions in which it develops. In this way, in the interaction of the student during the activity and in communication, psychic functions emerge.

From this perspective, analyzing the teaching-learning process of Chemistry, with attention to the influence of the social factor in relation to the professional needs of future technicians, requires assuming the contributions of the historical-cultural approach. In this sense, the genetic law of development as a Vygotskian presupposition, allows explaining the combination established between the internal processes of development and the external conditions, which arise in each stage of the student's development. This relationship determines the transit of psychic development during the evolutionary cycle, while the new psychological formations, which emerge at the end of each stage, cause the social situation of development.

From this category, it is considered that the student makes his individual realization viable through his social interaction, in the midst of the activity he develops in the workplace, in an active and goal-oriented way that harmonizes with the actual and potential levels (possibilities) to learn with the help of others. At the same time, he combines his internal processes with the external conditions proper to his stages of development, which allows the appearance of new psychological formations, through the interaction and influence exerted by the group, teachers and specialists of the working entity, in whose relationship his intrapsychological representation is built from the interpsychological.

In accordance with the above, the concept of Zone of Proximal Development is assumed. Taking this concept into account in the teaching-learning process of chemistry allows evaluating the student's actual level of development and potential development, determined through the solution of agrochemical problems, under the guidance of the mediators of the process. The above allows emphasizing that a structuring of the teaching-

learning process of Chemistry in the training of the Agronomy Technician, from a vision of professionalization of its contents, under the conditions of integration between the polytechnic school and the working environment, guarantees narrowing the gap between the actual development and the potential development of the students.

From this point of view, it is feasible to understand the teaching-learning process of Chemistry for the Agronomy Technician, in its relationship with the pedagogical principles that guide the Shared Professional Training Model (Mena, 2010), in correspondence with the principles for the teaching-learning process of Chemistry. Castillo *et al.* (2001).

The principle of subordination-adaptation of the teaching process to the characteristics of the productive process, demands the articulation of the teaching-learning process of Chemistry to the conditions of the agricultural productive process, from the contextualization of its content to the tasks and occupations required by the Professional Model; and the intentionality of the objectives of this process in correspondence with the object of the profession.

It starts from the study-work link, by means of the practical activity through which the student is oriented towards the search and solution of professional problems, with a flexible performance, with criteria of sustainability and conscience of producers. In this way, their independence, self-esteem, self-determination and self-confidence are favored, and they are prepared to coexist in society, and for their inclusion in labor entities.

On the other hand, the principle of the integrated nature of the teacher and the specialist-instructor for the direction of the practical teaching process in the work entity requires the necessary integration between the educators of the process (TVE teacher and the tutor of the work entity). Both, from their functions, socialize the knowledge of the science in which he/she is a specialist, from a teaching-learning process that takes place in the ETP contexts.

These pedagogical principles are articulated with the principles for the teaching-learning process of chemistry: integrating and systematizing character of the contents on the causal relationship structure-property-application in the study of chemicals, the principle of unity of the structural, thermodynamic and kinetic approach to the study of chemical reaction and experimentation in the teaching of chemistry.

The value of these principles as starting points for the direction of the teaching-learning process of Chemistry, with a professionalized character, lies in the fact that they provide essential elements that allow using the potentialities of the chemical contents from a didactic that considers the agricultural processes as a requirement for the development of the referred process in the polytechnic school and the working entity.

In relation to the above, the formative conception of the teaching-learning process in TVE is distinguished as a didactic foundation, which attends to the role of the formative contexts at this educational level, and recognizes the appropriation of the contents of the profession as a result of this process. From this point of view, an interpretation of the teaching-learning process of chemistry is required, which considers the essential elements that the previous definition provides in the professional order, as a starting point to professionalize its contents, in response to the demands of the professional model and to a didactics based on agricultural production processes.

In this order, it is recognized that the chemical contents take on a certain meaning for the student who is trained as an Agronomy Technician, due to their professional significance, which allows the development of motivations for their study, and a more solid assimilation process

With a professionalized approach, professional contents are assumed as:

> The part of the historical, social, cultural, scientific, technical and technological experience that is important, necessary, significant and useful for the technical bachelor, which allows him/her to have a comprehensive general and professional technical preparation, enabling his/her successful performance in accordance with social and labor interests (Mena, 2008, p. 70).

The convenience of sharing this definition lies in its conceptual depth and relevance, according to the objectives and tasks of the Professional Model, the guiding ideas and specific guidelines of Chemistry. This relationship favors the internalization of essential general ideas and judgments by students, through a didactics of Chemistry by agricultural production processes.

In accordance with the above, and with the ideas expressed, in which essential links between the objectives and tasks of the Professional Model and the didactic assumptions of Chemistry are exposed, in this research the basic agricultural productive processes are

declared as an integrating axis to professionalize the chemical content, in correspondence with the professional-basic tasks determined by the author herself, from the objectives for the first and second year.

These processes constitute the starting point for directing the teaching-learning process of chemistry, based on the guiding idea of the didactics of chemistry: the applications of substances are conditioned by their properties and, in turn, by their chemical structure. From this vision, the student internalizes essential general ideas, judgments, through their systematic treatment during the development of the contents of the Chemistry program. For this, it is necessary to take into account the actions that make it possible to contextualize the content and link it to the solution of agrochemical problems associated with real situations during the teaching-learning process in the essential contexts of TVE.

This guiding idea is articulated with the properties and applications of substances and interdisciplinarity as specific guidelines. These constitute the most concrete way for the selection and structuring of the essential chemical content (organic and inorganic components), which cross-cuts the whole formative process of the future Technician in Agronomy and which, in turn, becomes professional content. This vision allows the teaching-learning process of chemistry to be directed towards the solution of agrochemical problems in the context of TVE, from the general ideas of the didactics of chemistry that allow the selection and structuring of the essential chemical content to be internalized by the students in order to solve these problems.

Consequently, in the process under study, the student develops capacities, habits and skills from a system of cognitive and educational influences that result in consolidation and appropriation of the organic and inorganic components, as essential chemical content, through the systematization levels of essential knowledge that characterize and relate it to the basic agricultural and livestock production processes. In this order, the appropriation is based on concepts such as: substances, solutions, thermochemistry and kinetics of chemical reactions, metals and non-metals.

In the same way, through the association by hydrogen bridge, solubility coefficient, solubility curve, unsaturated solution, saturated solution, supersaturated solution, crystallization, concentration of the amount of substance, molar enthalpy of formation, activation energy, reaction rate, catalysis, atomic radius, ionization energy and molar volume and others that are systematized and deepened as electronegativity, metallic and

nonmetallic character, properties: oxidizing, reducing, acidic, basic, enthalpy, enabling formation, systematization. To interpret the concentration values of the amount of substance, solubility coefficient, enthalpy and molar enthalpy of formation.

These concepts are interrelated with the basic agricultural production processes from the interpretation and application of the laws of Avogadro and Hess, the theories of Brönsted-Lowry and collisions. Likewise, from illustrating some universal laws of materialistic dialectics such as: Law of unity and struggle of opposites when explaining the chemical properties of metals and non-metals, the Law of the transformation of quantitative changes into qualitative ones when studying the variations of properties in the periodic table of 18 columns, the Law of the negation of the negation. The general properties of organic compounds, as well as the classification of organic compounds, are also considered as part of the systematization levels of essential knowledge.

In general, the development of this content broadens and deepens the concept related to the chemical structure of substances and its influence on properties by introducing the concept of isomerism. Specific guidelines are also addressed such as: school chemical experiment, language of chemistry, polytechnic and labor training, ideopolitical training, interdisciplinarity and link with social practice.

In this direction, the levels of systematization of essential knowledge allow the student's cognitive activity to be channeled towards the appropriation of the essential elements of knowledge, starting from the transition from the simple to the complex, in relation to the basic agricultural and livestock production processes. Similarly, it leads to a process of appropriation of knowledge and skills, in which the student internalizes concepts, laws, chemical processes and theories associated with basic agricultural production processes, contributing to the solution of agrochemical problems in the context of TVE, as a dynamic agent of the economy of the territory where the polytechnic school is located, based on the new type of relationships with the different economic actors.

In this sense, it is valid to assume the appropriation of professional contents as:

> The various forms and resources through which this (student) actively and in intimate interrelation with teachers, specialists, instructors, the students of the group, as well as with the rest of the workers that make up the group, makes the professional contents his own and converts into personal qualities, the culture that

> characterizes the socio-labor environment in which he will work in the future (Mena, 2008, p. 49).

To achieve this appropriation requires a change in the way of articulating the chemical contents, so that the student can understand, explain and interpret in an integral way the processes and phenomena that occur in the agricultural and livestock work entities. In this order, the teacher directs the learning and guarantees its quality from the relationship between the intra and interpsychological planes, as the basis of the appropriation process of the chemical contents in a logic related to the path of knowledge, from the didactics of Chemistry and Agronomy as an applied science.

The student appropriates the essential chemical content with the help of the teacher, the specialist, the teaching group and the collective of workers of the work entity. The student also learns the procedures of each technological process of agricultural production and acquires ways and abilities to use them, thus manifesting modes of action inherent to what has been learned. To this end, practical activities must integrate them into the production process, with the purpose of familiarizing them with technology and state-of-the-art technological means.

In correspondence with the above, the solution of agrochemical problems requires articulating the properties and applications of substances, as a specific guideline of chemistry with the technical subjects that contribute to it, from interdisciplinary relationships, with which professionalization reaches a new nuance. This requires a theoretical analysis of professionalization.

Studies on professionalization currently constitute a field accessible to diverse perspectives of analysis in different careers at the middle and higher levels. The search conducted on the subject in the last five years revealed that, in general, the articles published revolve around: pedagogical professionalization, teacher professionalization and teaching professionalization.

The analysis of these researches evidenced that professionalization is a very studied category in the context of medical sciences in Cuba and in the management of the different processes carried out in the Educational Sciences.

Particularly, in the professionalization of teaching, the following have made incursions, among others: Cedeño *et al.* (2019), Delgado (2018), Milián *et al.* (2017); León *et al.* (2014), Cherrez (2023) and León (2007).

Despite their contributions, there is insufficient theoretical argumentation from the didactics of chemistry, around the relationship between chemical contents and professionals from the guidelines, which respond: to the object of the profession of the Middle Technician in Agronomy, to the productive reality and to the agrochemical problems, which are presented in the contexts of TVE.

There are several criteria and definitions of the concept of professionalization in the current educational context.

The study reveals the coexistence of at least three tendencies in pedagogical praxis regarding the treatment given to professionalization. The first tendency interprets it as a category of superior generality and related to social sciences such as labor sciences, sociology and educational sciences. This vision focuses on establishing the entire theoretical and practical platform of the educational process, from the administrative to the pedagogical. They adjust the role of the school, its relations with the contexts, the formative needs of the student and the relations with other socializing agencies. The fact that they advocate for an education that reduces the dichotomy between the education offered and the individual and social needs is considered interesting.

However, no necessary and sufficient arguments are offered to facilitate the development of a didactics by processes, which from the interdisciplinary point of view reinforces the professionalization of the chemical content in the Agronomy specialty. This requires the strengthening of the didactic character of this category.

From another perspective of analysis, professionalization is interpreted as a principle that confers certain general requirements to the training and development processes that take place in school contexts. The need to fix certain characteristics, as a principle, to the curricular design processes and to the execution of the training process, as a reflection of the professional's profile, is distinguished. It also highlights the role of knowledge as the axis for the establishment of professionalization. However, the influence of agricultural production processes in this process is not specifically mentioned.

A third tendency in relation to professionalization is to consider it as a process that enables the design of training processes for professionals, under certain practices, in different contexts. This criterion is shared for this research, since for the professionalization of chemical content, the relationship between the main contexts of TVE is vital, based on their functions in the training of the professional.

The need to consider requirements such as: the active and conscious attitude to achieve learning goals of the subject in training, and practical research training, criteria that are shared by the author, is emphasized. These positions, although they provide general elements that allow visualizing the professionalization process in several extensions, do not allow understanding it from the singularity of the professional model, the curriculum, in accordance with the demands and requirements of society to professionals. In the same way, it is considered that they do not particularize aspects that bring this process closer to didactics.

These shortcomings are overcome by Addine (2002), who alludes that "...professionalization should contribute to the formation and development of the professional mode of action, from a solid understanding of the role, tasks and functions, expressed in the characterization of the object, the logic and methods of science, the logic of the profession and a given historical context" (p. 15).

This definition is assumed, as it takes up the criterion of considering training in different contexts, the link between study and work and theory and practice, as well as the relationship between science and profession, based on social conditioning. The evaluations made of the concept of professionalization allow us to discern that it has different scopes. In this sense, the following are distinguished as essential features: a processual and continuous character, a dialectical relationship between thinking and doing, the applicability of aspects of science, technique and technology linked to the exercise of a profession, the logic and methods of science, the logic of the profession and the contexts of TVE.

These features constitute the starting point to understand and define a posteriori, the process of professionalization of the chemical content for the Agronomy specialty, in coherence with the assumed foundations of the didactics of chemistry and TVE. This will allow the teachers to understand how to structure the teaching-learning process of chemistry for the professionalization of its contents, so that the student can solve agrochemical problems in the essential contexts of TVE.

The approach to some of the current trends regarding professionalization corroborates that it continues to be a problem that demands a deep analysis given the edges that it presents and the great diversity of criteria and points of view about it. For the purposes of this research, we have chosen to assume it as a process.

It is appropriate to argue that understanding the teaching-learning process of Chemistry, with a focus on the professionalization of its contents, requires attending as a fundamental condition, the existence of a stable link between science and profession, from the agricultural productive processes as an integrating axis that is articulated with the guiding ideas, specific guidelines and essential professional content that transversalizes the whole process, as a new didactic logic. The above requires a definition that contains distinctive features of the particularities of the teaching-learning process of Chemistry, in relation to the demands of the model of the professional of the Middle Technician in Agronomy.

The systematized aspects reveal the main theoretical references, from which the teaching-learning process of the subject Chemistry and the professionalization of its contents are understood, and the essential theoretical deficiency is confirmed and argued. On this basis, a historical analysis is required to evaluate the behavior of both processes in different periods of time.

Conclusions

The epistemological analysis carried out reveals as a theoretical deficiency: Insufficient theoretical argumentation in the didactics of Chemistry, of the relationship between chemical contents and professionals, based on an integrating axis in which the following are articulated: the object of the profession of the Middle Technician in Agronomy, the productive reality and the agrochemical problems that arise in the contexts of TVE.